CLAIMS

What is claimed:

1. A method, comprising:

forming a high-concentration, indium-fluorine retrograde well within a substrate, the indium-fluorine retrograde well having an indium concentration greater than about 3E18/cm3.

2. The method of claim 1, wherein forming the indium-fluorine retrograde well comprises:

mixing indium atoms and fluorine atoms together inside a portion of the substrate; and

annealing the substrate with the indium atoms and the fluorine atoms to activate the indium, the fluorine preventing the indium from substantially diffusing during annealing.

3. The method of claim 1, wherein forming the indium-fluorine retrograde well comprises:

implanting indium ions into an area of the substrate at a dosage above about 2E13/cm2 at an energy above about 30keV;

implanting fluorine ions into the same area of the substrate at a dosage above about 2E14/cm2 at an energy between about 5keV – 25keV; and

annealing the substrate at a temperature above 700° C.

4. A method, comprising:

implanting fluorine ions at a dosage above about 2E14/cm2 at an energy between about 5keV – 25keV into a substrate surface to form a region of fluorine atoms;

implanting indium ions at a dosage above about 2E13/cm2 at an energy above about 30keV into the region of fluorine atoms to form an indium-fluorine ion mixture inside the substrate; and

annealing the indium-fluorine ion mixture to activate the indium ions forming an activated indium-fluorine retrograde well having an indium concentration greater than about 3E18/cm3, the fluorine preventing the indium from substantially diffusing during the annealing.

5. The method of claim 4, including annealing the indium-fluorine ion mixture at a temperature above about 700°C.

6. The method of claim 4, including implanting the indium ions into the substrate a dose of about 4E13/cm2 at an energy of about 50keV and implanting the fluorine ions into the substrate surface at a dose of about 2E15/cm2 at an energy between about 10keV to about 12keV, to form an indium profile with a concentration peak at about 1E19/cm3.

7. The method of claim 4, including implanting the indium ions and the fluorine ions at an approximately vertical angle to the substrate surface.

8. The method of claim 4, wherein at least one gate structure is formed on the substrate surface and further including implanting the indium ions and the fluorine ions at an angle other than 90° underneath the gate structure to form the indium-fluorine retrograde well beneath the gate structure.

9. A method, comprising:

forming at least one gate structure on a substrate surface;

implanting fluorine ions and indium ions into the substrate surface using an angled implant to form an indium-fluorine ion mixture inside the substrate underneath the gate structure; and

annealing the indium-fluorine ion mixture to activate the indium ions forming an activated indium-fluorine retrograde well, the fluorine preventing the indium from substantially diffusing during the annealing allowing an indium concentration greater than about 3E18/cm3.

10. The method of claim 9, including implanting the fluorine ions at a dosage above about 2E13/cm2 at an energy above about 30keV and implanting the fluorine ions at a dosage above about 2E14/cm2 at an energy between about 5keV.

11. The method of claim 9, including implanting the fluorine ions and the indium ions at an angle of about 20° to about 40° from the substrate surface.

12. An apparatus, comprising:

an indium-fluorine retrograde well inside a substrate, the indium-fluorine retrograde well including an indium concentration greater than about 3E18/cm3.

13. The apparatus of claim 12, wherein the indium-fluorine retrograde well includes an indium concentration three times, or more, greater than 3E18/cm3.

14. The apparatus of claim 12, wherein the indium-fluorine retrograde well includes a fluorine concentration between about 5E18/cm3 to about 3E20/cm3.

15. The apparatus of claim 12, wherein the indium-fluorine retrograde well includes an indium concentration peak at about 200Å, or deeper, below the substrate surface.

16. An integrated circuit, comprising:

a substrate;

a gate structure formed on the substrate; and

an indium-fluorine retrograde well formed to a shallow depth below a surface of the substrate and beneath the gate structure.

17. The integrated circuit of claim 16, comprising an indium concentration above about 3E18.

18. The apparatus of claim 16, wherein the indium-fluorine retrograde well includes an indium concentration three times, or more, greater than 3E18/cm3.

19. The apparatus of claim 16, wherein the indium-fluorine retrograde well includes a fluorine concentration between about 5E18/cm3 to about 3E20/cm3.

20. The integrated circuit of claim 16, wherein the indium has a concentration peak at about 200Å, or deeper, below the substrate surface.

21. An apparatus, comprising:

a gate structure overlying a silicon substrate;

source/drain regions inside the silicon substrate, the source/drain regions adjacent to opposing sides of the gate structure and extending slightly underneath the gate structure; and

a fluorine-indium retrograde well directly beneath the gate structure and between the source/drain regions, the fluorine-indium retrograde well including an indium concentration greater than 3E18/cm3.

22. The apparatus of claim 21, wherein the fluorine-indium retrograde well is to provide a threshold voltage greater than about 360mV.

23. The apparatus of claim 21, wherein the fluorine-indium retrograde well includes an indium concentration peak at about 200Å, or deeper, below the substrate surface.

24. The apparatus of claim 21, wherein the gate structure has a gate length of about 60nm or less.

25. The apparatus of claim 21, wherein the fluorine-indium retrograde well includes an indium concentration three times, or more, greater than 3E18/cm3.